

First Record of Two Hyperiid Amphipods, *Phronima atlantica* and *Oxycephalus clausi*, from Dokdo, Korea

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ABSTRACT

The suborder Hyperiidea is an abundant crustacean zooplankton in pelagic communities with copepods and euphausiaceans. Hyperiidean amphipods are known to be commensals or parasites of gelatinous organisms such as medusae, siphonophores, ctenophores, and salps. Korean hyperiid amphipods have not received taxonomical attention since the 1970s. During a survey of pelagic crustacean species, two species of hyperiid amphipods, *Phronima atlantica* Guérin-Méneville, 1836 belonging to the family Phronimidae and *Oxycephalus clausi* Bovallius, 1887 belonging to the family Oxycephalidae, were found on Dokdo, East Sea, Korea. These two species are new to Korean waters. In the present study, we provide descriptions and illustrations of these two hyperiid species.

Keywords: Amphipoda, Hyperiidea, Phronimidae, Oxycephalidae, Crustacea

INTRODUCTION

The suborder Hyperiidea H. Milne Edwards, 1830, an entirely pelagic amphipod group, occur as abundant crustacean zooplankton in pelagic communities together with copepods and euphausiaceans (Bowman, 1960; Bowman and Gruner, 1973; Vinogradov, 1999). Members of the Hyperiidea occur in oceans worldwide where they occupy the epi-, meso-, and bathypelagic zones (Vinogradov, 1999; Zeidler and De Broyer, 2009). Hyperiidean amphipods play important roles in marine food-web dynamics as planktonic prey (Vinogradov et al., 1996; Zeidler and De Broyer, 2009), and they are also known to be commensals or parasites of other pelagic organisms. Gelatinous organisms such as medusae, siphonophores, ctenophores, and salps, are representative hosts of the hyperiid amphipods (Diebel, 1988; Gasca and Haddock, 2004, 2016). According to recent studies, most hyperiideans are considered temporary symbionts associated with gelatinous zooplankton (Gasca et al., 2007, 2015; Mazda et al., 2019). These amphipods are also considered an interesting group for studying about symbiotic relationships between the hyperiids and gelatinous zooplanktons as these associations frequently occur in deep-waters (Gasca et al., 2007, 2015;

Gasca and Haddock, 2016; Mazda et al., 2019).

More than 280 hyperiidean species have been recorded in the world's oceans (Horton et al., 2020); however, Korean hyperiid amphipods have not received considerable attention thus far. Before the early 1960s, a few studies conducted by foreign scientists recorded a small number of the hyperiid species that occur near Korea, otherwise other hyperiid taxa were identified only to the genus level (Yamada, 1933; Irie, 1959; Bowman, 1960). In the late 1960s, ten hyperiid species were reported to distribute in the sea adjacent to eastern Korea (Hue, 1967). The study, however, did not address hyperiidean taxonomy but merely provided information on species lists and their distributions. Taxonomic research on Korean hyperiidean amphipods was initiated by Yoo in 1972, after which 16 hyperiid species were described in a monograph of Korean marine zooplankton by Yoo (1995). Subsequently, 17 hyperiidean amphipod species were recorded in Korea (The Korean Society of Systematic Zoology, 1997).

Until recently, 142 species of hyperiid amphipods have been known to occur in Japanese waters (Mori et al., 2010); however, regarding Korean hyperiids, no remarkable taxonomic research has been conducted since the 1970s. To

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the best of our knowledge, only ecological studies on marine plankton and fish food organisms have been performed on hyperiids in Korea. Consequently, the total number of 17 hyperiidean amphipod species occurring in Korean waters has not been revised through taxonomic study to date; these species are *Brachyscelus cruscum* Spence Bate, 1861, *Hyperia galba* (Montague, 1813), *Hyperoche medusarum* (Krøyer, 1838), *Themisto compressa* Goës, 1866, *T. japonica* (Bovallius, 1887), *Lestriginus latissimus* (Bovallius, 1889), *L. schizogeneios* (Stebbing, 1888), *Hyperioides longipes* Chevreux, 1900, *Simorhynchotus antennarius* (Claus, 1871), *Streetsia porcella* (Claus, 1879), *Rhabdosoma brevicaudatum* Stebbing, 1888, *Parascelus edwardsi* Claus, 1879, *Phrosina semilunata* Risso, 1822, *Primno macropa* Guérin-Méneville, 1836, *Vibilia viatrix* Bovallius, 1887, *Phronima sedentaria* (Forskål, 1775), and *Phronimella elongata* (Claus, 1862).

During a survey of pelagic crustacean species, two species of hyperiid amphipods, *Phronima atlantica* Guérin-Méneville, 1836 belonging to the family Phronimidae Rafinesque, 1815 and *Oxycephalus clausi* Bovallius, 1887 belonging to the family Oxycephalidae Dana, 1852, were found from Dokdo, East Sea, Korea. These species were recorded for the first time in Korean waters. We provide descriptions and illustrations of these two hyperiideans.

The specimens were collected using a light-trap at Dongdo dock, Dokdo, East Sea, Korea, on 29 Apr 2016 (Fig. 1). Specimens were fixed and preserved in 100% ethanol, and dissections and mounting were conducted according to the methodology of Barnard and Karaman (1991). Line drawings were produced using the technique described by Coleman (2003, 2009). Body length was measured along the intestinal line from the tip of the rostrum to the posterior end of the urosome. All specimens examined herein were deposited at the National Marine Biodiversity Institute of Korea (MABIK).

SYSTEMATIC ACCOUNTS

Order Amphipoda Latreille, 1816

Suborder Hyperiidea H. Milne Edwards, 1830

Family Phronimidae Rafinesque, 1815

Genus *Phronima* Latreille, 1802

Phronima atlantica Guérin-Méneville, 1836

Phronima atlantica Guérin-Méneville, 1836: 21, Pl. 25, fig. 4; Zeidler, 1978: 13, figs. 9–10; 1992: 105; 2004: 12; Vinogradov et al., 1996: 417, fig. 179; Mori et al., 2010: 45 (list).

Material examined. Korea: 2♀♀, Gyeongsangbuk-do, Ul-

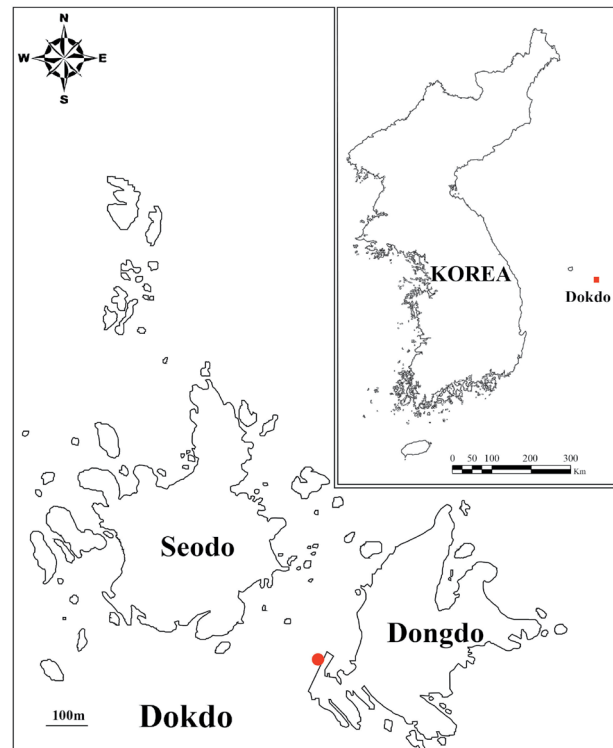


Fig. 1. Map of Dokdo, Korea, showing the collecting locality.

leung-gun, Ulleung-eup, Dokdo-ri, 37°14'22.80"N, 131°52'3.70"E, 29 Apr 2016.

Description. Based on adult female, 17.5 mm (Fig. 2). Body transparent, slender, elongated.

Head (Fig. 2) much deeper than wide, longer than combined length of pereonites 1–2. Eyes well developed, large ommatidia covering dorsal and lateral surfaces and small ommatidia constituting ventrolateral part of head.

Pereon (Fig. 2). Pereonite 7 longer than pleonite 1.

Gnathopod 1 (Fig. 3A) simple, subchelate, merus to propodus covered with stiff setae; basis slightly convex posteriorly; merus slightly longer than ischium, posterodistal corner subacute; carpus longer than wide; carpal lobe extending beyond one-third of propodus length; propodus shorter than carpus.

Gnathopod 2 (Fig. 3B) similar to gnathopod 1, but slender and longer than gnathopod 1; basis approximately 1.5 times longer than that of gnathopod 1; carpal lobe extending to one-third of propodus length.

Pereopod 5 (Fig. 3C) enlarged, subchelate; basis narrowest at proximal end, with distinct posterodistal tooth; ischium with anterodistal tooth, convex posteriorly; merus strongly convex posteriorly; carpus much longer than wide, anterior margin strongly concave at proximal part, with two mid-medial protuberances (anteromedial tubercle small and acute, posteromedial tubercle with 5 distinctive crenulated posterior

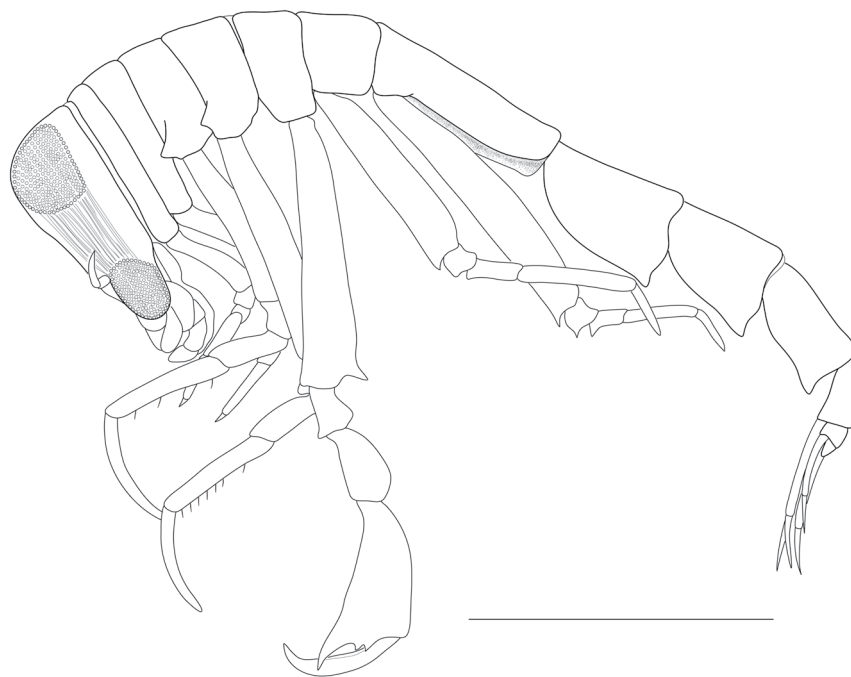


Fig. 2. *Phronima atlantica* Guérin-Ménéville, 1836, female. Habitus. Scale bar = 5 mm.

teeth); carpal process pointed and triangular, extending to and touching two-thirds of propodus length, longer than medial protuberances, anterodistal margin slightly convex, ventral inner margin strongly concave; propodus long, tapering and curved, overreaching carpal process.

Pereopod 6 (Fig. 3D) basis with small anterodistal tooth, posterior margin slightly convex; ischium with mid-anterior process; merus with distinctive anteroproximal process; carpus 2 times as long as propodus; dactylus small.

Pleon (Fig. 2). Epimeral plates 1–3 with subacute tooth on posteroventral corners.

Urosomes (Fig. 3E). Peduncles of uropods 1–3 broadened distally. Uropod 1, peduncle approximately 2 times as long as rami; rami equal in length. Uropod 2, peduncle 2 times as long as inner ramus; outer ramus slightly longer than inner ramus. Uropod 3, peduncle reaching beyond distal end of uropod 2 peduncle; rami with minutely serrated inner margins; peduncle 2 times as long as inner ramus; inner ramus slightly longer than outer ramus. Telson small, apically rounded.

Remarks. Members of the genus *Phronima* possess an elongated and enlarged pereopod 5, which is distinctive. The enlarged carpus protruded into a large tooth anteriorly. *Phronima atlantica* is very similar to *P. sedentaria* (Forskål, 1775). In these two species, pereopod 5 has an elongated carpus and an overreaching propodus extending to the palm. In *P. atlantica*, the carpal tubercle of pereopod 5 is bifid in males and females, and the carpal process of pereopod 5 overlaps with

the propodus. In *P. sedentaria*, however, the carpal tubercle is single in females and bifid in males, and the carpal process is extremely strong and extends beyond the propodus. Moreover, the inner ramus of uropod 2 is slightly shorter than the outer ramus in *P. atlantica*, whereas in *P. sedentaria*, it is half the length of the outer ramus. Our specimens correspond with the previous descriptions of *P. atlantica* in terms of the morphological characteristics (Zeidler, 1978; Vinogradov et al., 1996).

Family Oxycephalidae Dana, 1852

Genus *Oxycephalus* H. Milne Edwards, 1830

***Oxycephalus clausi* Bovallius, 1887**

Oxycephalus clausi Bovallius, 1887: 35; Zeidler, 1978: 32, fig. 31; 1992: 120; 1999: 411, figs. 1C, 12–15; Vinogradov et al., 1996: 504, fig. 219; Mori et al., 2010: 46 (list).

Material examined. Korea: 1 ♀, Gyeongsangbuk-do, Ull-eung-gun, Ulleung-eup, Dokdo-ri, 37°14'22.80"N, 131°52'3.70"E, 29 Apr 2016.

Description. Based on adult female, 27.2 mm (Fig. 4). Body transparent, elongated, sculpture pronounced.

Head (Fig. 4) beak-like shaped, with long and pointed rostrum, as long as combined length of pereonites 1–4. Eyes well developed, large, ommatidia occupying median surface part of head.

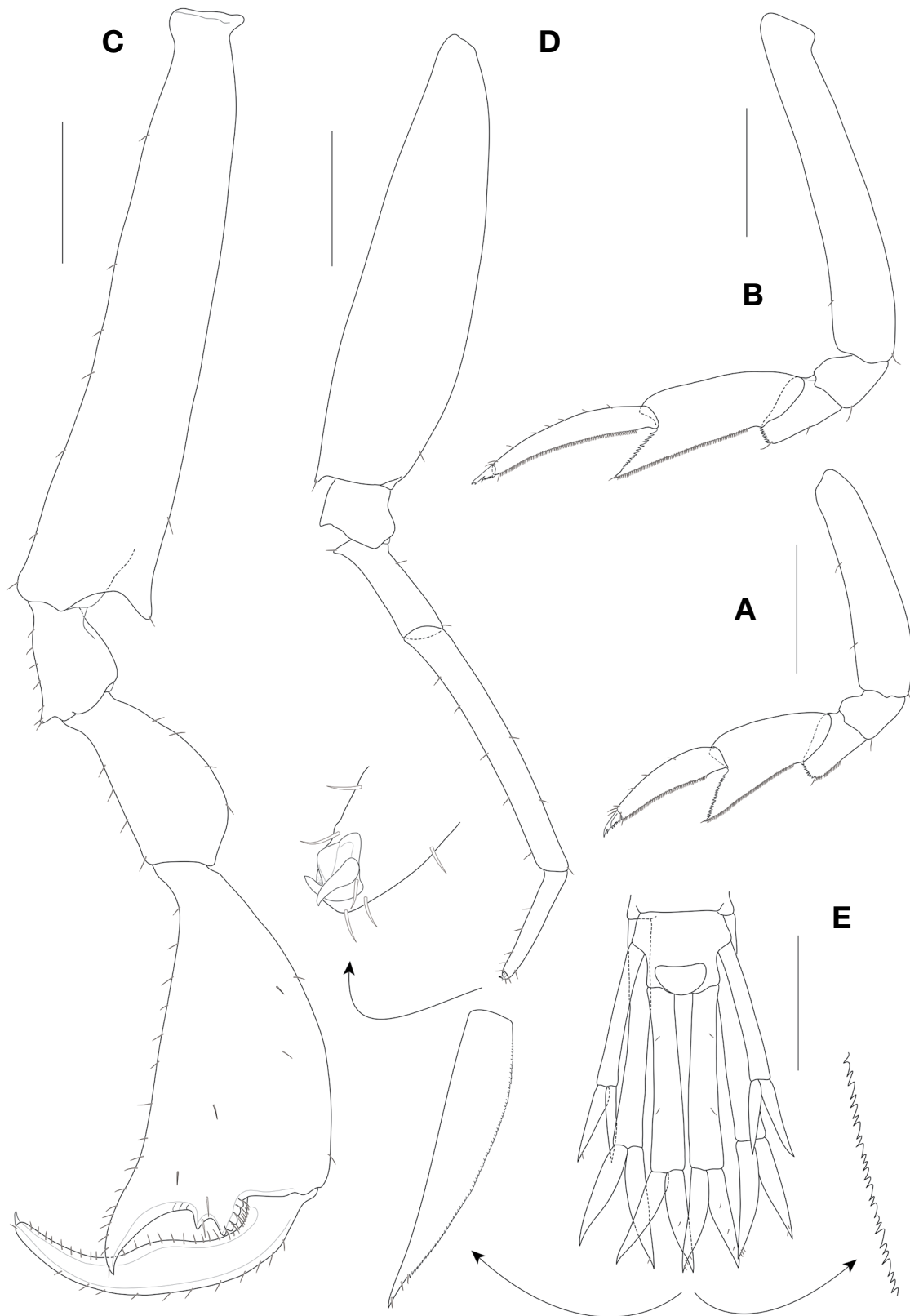


Fig. 3. *Phronima atlantica* Guérin-Méneville, 1836, female. A, Gnathopod 1; B, Gnathopod 2; C, Pereopod 5; D, Pereopod 6; E, Uropods and uropods 1-3. Scale bars: A, B=0.5 mm, C-E=1 mm.

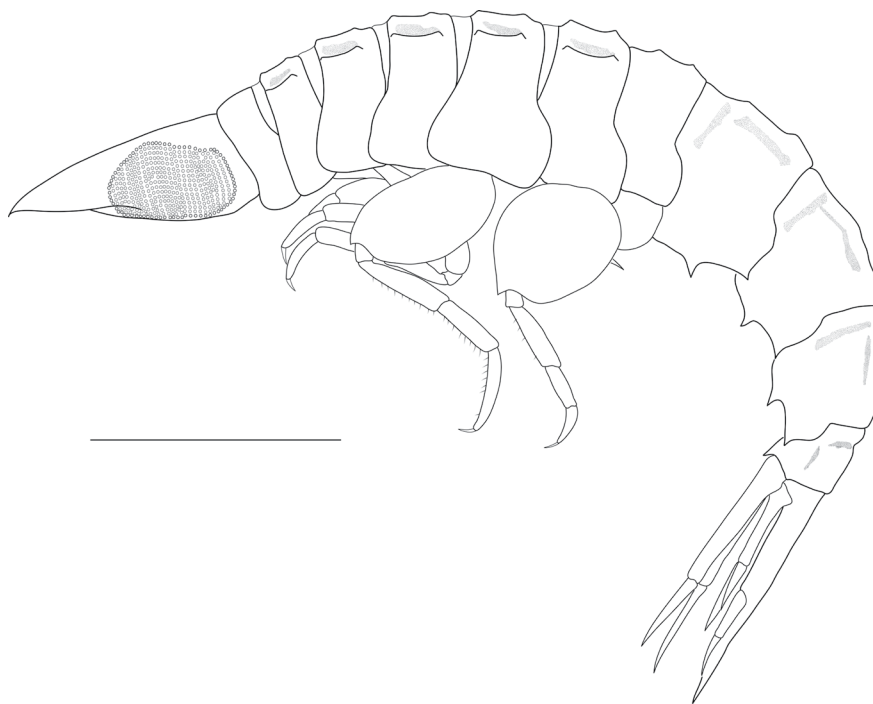


Fig. 4. *Oxycephalus clausi* Bovallius, 1887, female. Habitus. Scale bar=5 mm.

Pereon (Fig. 4) carina pronounced dorsally and mid-dorsally.

Gnathopod 1 (Fig. 5A) chelate; basis expanded, widest at central portion; carpus convex anteriorly, with acute tooth on anterior corner; carpal process pitted with propodus, and medial margin with 4 irregular teeth; propodus round and swelled, expanded posterodistally, with serrated teeth on median margin.

Gnathopod 2 (Fig. 5B) chelate, similar to gnathopod 1, but longer than gnathopod 1; basis approximately twice as long as that of gnathopod 1; carpus and propodus elongated, carpal process pitted with propodus, with acute tooth on anterodistal corner distinctly, median margin serrated weakly; propodus shorter than carpal process, not swollen, with median saw-teeth weakly.

Pereopod 5 (Fig. 5C), reduced in size; basis sub-ovate, widest at one-third of basis length, as long as combined length of articles 3–7; merus longer than carpus; carpus slightly longer than propodus; dactylus minute.

Pleon (Fig. 4). Epimeral plates 1–3 with distinctive pointed teeth on ventromedian margin and posteroventral corner, respectively.

Urosomes (Fig. 5D). Uropod 1, inner ramus longer than outer ramus. Uropods 2 and 3, peduncles fused with inner rami; outer rami longer than inner rami. Telson extending beyond end of uropod 3.

Remarks. *Oxycephalus clausi* is distinguishable from all other described congeners by the following characteristics: carpi of gnathopods 1–2 with an acute process on anterodistal corner; epimera 1–3 bearing a distinct median tooth on the ventral margin and an acute tooth on the posterodistal corner. *Oxycephalus clausi* is similar to *O. piscator* regarding gnathopods 1–2 and epimera 1–3; however, carpi of the gnathopods 1–2 of *O. piscator* are rounded without teeth, and are slender in shape than those of *O. clausi*. Moreover, all epimeral plates of *O. piscator* have a smooth ventral margins, and there are no teeth. Our specimens showed the typical morphological characteristics of *O. clausi* (Vinogradov et al., 1996; Zeidler, 1999).

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CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

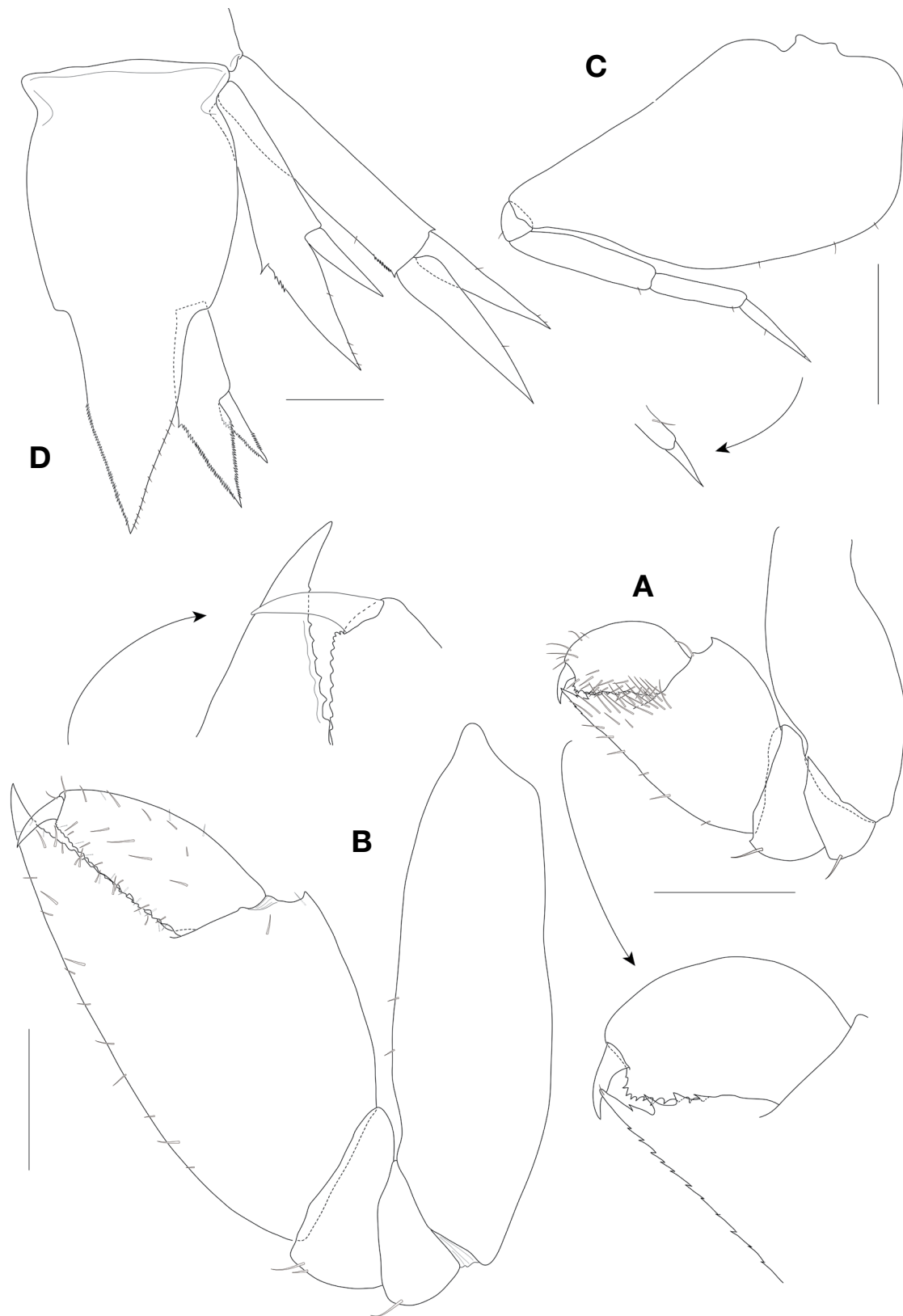


Fig. 5. *Oxycephalus clausi* Bovallius, 1887, female. A, Gnathopod 1; B, Gnathopod 2; C, Pereopod 5; D, Urosomes and uropods 1–3. Scale bars: A–D=1 mm.

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